bination proved in his hands very successful, though his galvanometer was not the most sensitive possible, since it was a matter of importance that the needle should quickly come to rest. As actually adjusted, the galvanometer gave a deflection of one scale division for 0·00000007 ampere, the period being 10 seconds.

The two principal points to which attention was directed were the comparative intensity of radiation of the sun and moon and the coefficient of transmission of our atmosphere for lunar radiations. The first point was determined by two methods: in one, but a very small fraction of the sun's rays were suffered to fall on the thermograph; whilst in the second method a resistance was interposed in the galvanometer. The two methods gave very fairly accordant results, the mean giving the solar radiation as 184,560 times the lunar. The experiments on the transmission of the lunar rays through our atmosphere gave a remarkably high value; for the deduced result showed that 89¼ per cent. of the rays of the moon when vertical are transmitted by the air at standard pressure.

Observations on the lunar eclipse of January 28, 1888, agreed with those of Langley and Lord Rosse in their testimony as to the suddenness with which the heat received from the moon is cut off at totality.

As to the quality of the lunar rays, it was found that but 31 per cent. were transmitted through a plate of quartz which allowed 93 per cent. of the sun's rays to pass. The radiations from a platinum coil placed in a Bunsen flame turned down as low as possible, suffered to about the same extent as the rays from the moon. From experiments upon the radiating powers of different rocks, a table of which has been formed, Prof. Hutchins concludes that a very considerable portion, about half indeed, of the incident rays are absorbed. The surface of the moon should therefore become strongly heated, but the evidence afforded by total lunar eclipses appears to show that scarcely any of this surface heat succeeds in passing through our atmosphere.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1889 JUNE 30—JULY 6.

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on June 30

Sun rises, 3h. 49m.; souths, 12h. 3m. 24·6s.; daily increase of southing, 11·8s.; sets, 20h. 18m.: right asc. on meridian, 6h. 38·4m.; decl. 23° 10′ N. Sidereal Time at Sunset, 14h. 54m.

Moon (at First Quarter on July 6, 6h.) rises, 5h. 35m.; souths, 13h. 48m.; sets, 21h. 54m.: right asc. on meridian, 8h. 22·9m.; decl. 21° 21′ N.

Planet.	Rises. h. m.	Souths. h. m.	Sets. h. m.	Right asc. on meridian. h. m.	Declination on meridian. ° ′
Mercury..	3 14	11 0	18 46	5 35·2	18 47 N.
Venus ...	1 28	8 53	16 18	3 27·8	15 19 N.
Mars ...	3 26	11 48	20 10	6 23·2	24 8 N.
Jupiter ...	19 40	23 34	3 28*	18 11·3	23 16 S.
Saturn ...	7 17	14 48	22 19	9 23·8	16 29 N
Uranus ...	13 0	18 31	0 2*	13 6·9	6 27 S.
Neptune..	1 43	9 32	17 21	4 6·7	19 16 N.

* Indicates that the setting is that of the following morning.

Variable Stars.

Star.	R.A. h. m.	Decl. ° ′		h. m.	
U Cephei	0 52·5	81 17 N.	July 4	21 46	*m*
U Virginis	12 45·5	6 10 N.	June 30,		*m*
Z Virginis	14 4·4	12 47 S.	July 6,		*M*
U Boötis	14 49·2	18 9 N.	,, 1,		*m*
S Ophiuchi	16 27·9	16 56 S.	,, 1,		*M*
U Ophiuchi	17 10·9	1 20 N.	,, 2,	3 11	*m*
			,,	23 19	*m*
X Sagittarii	17 40·6	27 47 S.	June 30,	22 0	*M*
			July 5,	2 0	*m*
W Sagittarii	17 57·9	29 35 S.	,, 1,	0 0	*m*
U Sagittarii	18 25·6	19 12 S.	,, 2,	0 0	*M*
R Lyræ	18 52·0	43 48 N.	,, 6,		*m*
η Aquilæ	19 46·8	0 43 N.	,, 3,	1 0	*m*
X Cygni	20 39·1	35 11 N.	,, 2,	22 0	*m*
T Vulpeculæ	20 46·8	27 50 N.	June 30,	21 0	*M*
δ Cephei	22 25·1	57 51 N.	July 6,	22 0	*m*

M signifies maximum; *m* minimum.

July.	h.	
1	1	Mercury stationary.
1	19	Saturn in conjunction with and 2° 3′ south of the Moon.
1	21	Sun at greatest distance from the Earth.

GEOGRAPHICAL NOTES.

To an unusually crowded meeting of the Royal Geographical Society on Monday night Dr. Frithjof Nansen told in detail the story of his journey across Greenland last summer. We have already given the main incidents of this remarkable journey, and need only refer here to some of the scientific results. These cannot be fully given as yet, as the meteorological and other data collected by Dr. Nansen have not been fully worked out. It should be borne in mind that the main purpose of Dr. Nansen's expedition was to prove that it is quite possible to cross Greenland: in this respect the expedition has been completely successful. Dr. Nansen repudiates as untenable the idea that somewhere in the interior of Greenland an oasis of greenery must exist. The conditions there are quite different from those of Grinnell Land, where the winter's snow is annually melted away over a certain extent of the surface. Greenland, on the contrary, Dr. Nansen maintains, is so thickly covered with the ice-accumulations of ages, that no part of the interior is ever laid bare. He surmises that there is a sort of wind-pole about the high centre of the interior, from which, as a rule, the cold winds radiate in all directions to the warmer coasts. The cold experienced by the expedition reached as low as 90° F. below freezing, and as Dr. Nansen's thermometers were not adapted for a lower temperature he believes that the temperature was at times much under that. He compares the configuration of the inland ice to a shield, curving upwards from the edges to a sort of plateau, reaching in parts at least 10,000 feet above sea-level. As to the configuration of the ground underneath, Dr. Nansen maintains that it must be similar to Norway and Scotland, with the same rugged mountain masses, high ridges, valleys, and fjords; and that the shape of the ice-covering has nothing to do with the shape of the land underneath. The immense accumulation of snow has levelled up everything; in places the ice must be 6000 feet deep, and even the tops of the mountains must be covered with hundreds of feet of glacier. He believes the wind has much to do with maintaining the ice-level, and does not believe that the quantity of snow varies much from year to year. The enormous pressure exercised by this vast mass of ice causes it to send off icebergs, and, in Dr. Nansen's opinion, running water helps to maintain the uniform level. Even in winter, he maintains, there are running streams underneath, due to the action of this pressure, and which help to prevent the growth of the mass. From a meteorological point of view the scientific exploration of Greenland is in Dr. Nansen's estimation of immense importance. He therefore means to return to the country, probably in the autumn of next year. He will land on the east coast, much further north than his last year's starting-point. He will endeavour to explore the east and north coasts, and will attempt to cross the continent at its broadest part.

In illustration of Dr. Nansen's paper a large collection of oil paintings of Greenland scenery was exhibited, by a Danish artist, Mr. Carstensen, who spent two summers and autumns travelling up and down the west coast. They show, better than any photographs, the wonderful colour of the Greenland landscapes, the extent and nature of the ice, and the beauty and richness of the vegetation during the short summer of this ice-bound land.

THE LADIES' CONVERSAZIONE OF THE ROYAL SOCIETY.

THE Ladies' *Conversazione* of the Royal Society, given on June 19, was a great success. The following were among the objects exhibited:—

Exhibited by Miss Constance F. Gordon Cumming:—Sketches near the active volcano of Mauna Loa, on the Island of Hawaii, and the extinct crater of Haleakala, on Isle Maui, described in "Fire Fountains of Hawaii."

Exhibited by Prof. Silvanus P. Thompson:—(1) Acoustic apparatus illustrating polarization of light. (2) Magnetic rotation of plane of polarization shown by projecting a polarized beam through a bar of heavy glass, and analyzing by a 24-ray disk of mica, or by a fish-lens. (3) Expansion and contraction, by transverse electrification, of the rings seen in quartz by convergent polarized light. (4) Objects electro-plated with the metal cobalt (new process).

Exhibited by the Hon. Ralph Abercromby:—Photographs and specimen, and map, illustrative of the nitrate of soda industry, and of the nitrate country.—Sun distilling apparatus, on the Atacama desert. This apparatus is situated at Sierra Gorda, near Caracoles, and is the property of Signor Oliveira. It consists of 1875 square feet of glass, something like a row of cucumber frames. A thin layer of salt water is led under the glass, when the heat of the sun vaporizes some of the water, which condenses as a sweat on the under surface of the glass top. The drops gradually coalesce, trickle down into the narrow groove on which the panes of glass rest, and are then led by pipes into a reservoir of fresh water. The bars along the outside of the glass are to save the apparatus from being wrecked by whirlwinds. Rather more water distils by night than by day, owing to the better condensation when the outer air is cool. At the time of my visit the outer air was 97°, the air inside the frames 120°, and that of the salt water inside only 117°, while that of the glass frame itself could not be determined. The apparatus is extremely inefficient, owing to the absence of a proper condenser, and the details are bad; still, from 150 to 175 litres of fresh water are distilled every day, which is sold at a profit for 1½*d.* a gallon. Twenty years ago a similar apparatus, with 50,000 square feet of glass, was erected at Carmen Alto on the same desert, and worked very profitably, as 10*s.* a gallon could then be obtained for fresh water. This apparatus was afterwards wrecked by a whirlwind, and is now replaced by a steam condenser.

Exhibited by Mr. Streeter:—Rubies from the Burmah Mines, English cut and mounted, and in the rough as found.

Exhibited and invented by Mr. Ludwig Mond and Dr. Carl Langer:—New form of gas battery. This battery is an improvement on the well-known gas battery invented by Grove fifty years ago, which produces electricity from hydrogen and oxygen gas by the intervention of platinum. The distinguishing feature of the new battery, which has been designed to obtain large currents of electricity by means of these gases, is that the electrolyte is not employed as a mobile liquid, but in a quasi-solid form, and it is therefore named "dry gas battery." Each element of the battery consists of a porous diaphragm of a non-conducting material—for instance, plaster of Paris—which is impregnated with dilute sulphuric acid. Both sides of this diaphragm are covered with very fine platinum leaf, perforated with very numerous small holes, and over this with a thin film of platinum black. Both these coatings are in contact with frame-works of lead and antimony, insulated one from the other, which conduct the electricity to the poles of each element. A number of these elements are placed side by side, or one above the other, with non-conducting frames intervening, so as to form chambers through which hydrogen gas is passed along one side of the element, and air along the other. One element, with a total effective surface of 774 square centimetres = 120 square inches, which is covered by 1 gramme of platinum black and 0·35 gramme of platinum leaf, shows an electromotive force of very nearly 1 volt when open, and produces a current of 2 amperes and 0·7 volt or 1·4 watt, when the outer resistance is properly adjusted. This current is equal to nearly 50 per cent. of the total energy obtainable from the hydrogen absorbed in the battery. The electromotive force decreases, however, slowly, in consequence of the transport of the sulphuric acid from one side of the diaphragm to the other. In order to counteract this disturbing influence the gases are from time to time interchanged. The battery works equally well with gases containing 30 to 40 per cent. of hydrogen, such as can be obtained by the action of steam or steam and air on coal or coke, if the gases have been sufficiently purified from carbonic oxide and hydrocarbons. The water produced in the battery by the combination of hydrogen and oxygen is carried off by the unconsumed nitrogen and an excess of air carried through it for this purpose.

Exhibited by Messrs. Woodhouse and Rawson, Ltd.:—Samples of copper produced by the Elmore depositing process. Sketches of the appearance under the microscope of ordinary deposited copper, and copper made by the Elmore process. By the Rev. F. Howlett, F.R.A.S.

Exhibited by Prof. J. A. Fleming, D.Sc.:—Edison Swan incandescence lamps, showing the "Edison effect." If a carbon incandescence lamp has a platinum plate, carried on a wire sealed through the glass, placed between the loop or horse-shoe, it is found that when the lamp is in action a galvanometer connected between the middle plate and the *positive* side of the carbon loop shows a current passing. If the galvanometer is placed between the middle plate and the *negative* side of the loop no current is found. The lamps exhibited show this effect very well. It was first pointed out by Mr. Edison, in 1884. It has been found that shielding the negative leg by a glass or metal tube entirely stops the production of the effect.

Exhibited by the Director of the Royal Gardens, Kew:—Photographs of Ceylon vegetation.

Exhibited by Mr. J. Young:—(1) A cluster of nests of a species of swift (Collocalia) taken in one of the Society Islands. (2) A specimen of *Pluvianellus sociabilis*, a plover obtained in South America, of which only two specimens (obtained fifty years ago) were previously known in Europe. (3) The tail of a Japanese barndoor cock, 11 feet long. (4) Bearded-tits' nest, built in Pampas grass heads, stuck in a flower-pot in an aviary.

Exhibited by Mr. P. L. Sclater, F.R.S.:—(1) Head of Thomson's gazelle (*Gazella thomsoni*), from a specimen shot by Mr. H. C. V. Hunter, in Masai Land, Eastern Africa. This gazelle was discovered by Mr. Joseph Thomson during his expedition through Masai Land in 1883–84, and named after its discoverer by Dr. Günther (*Ann. Nat. Hist.*, ser. 5, vol. xiv. p. 427). (2) Head of Grant's gazelle (*Gazella granti*), from a specimen shot by Mr. Frederick Holmwood, C.B., in the Kilimanjaro district of Eastern Africa. This gazelle was discovered by Colonel Grant, C.B., F.R.S., in Ugogo, in 1860, and named after him by Sir Victor Brooke (P.Z.S., 1872, p. 601). (3) Mummy of a small falcon (probably the kestrel, *Tinnunculus alaudarius*) from the tombs at Thebes in Egypt, obtained from the natives by Mr. A. G. Scott. (4) Tray of birdskins, from St. Lucia, West Indies, collected by Mr. Ramage, the naturalist employed by the joint Committee of the Royal Society and British Association for the exploration of the Lesser Antilles.

Exhibited by Profs. Liveing and Dewar, F.R.S.:—Absorption spectrum of oxygen. The oxygen, compressed to 150 atmospheres, is contained in a steel tube fitted with quartz ends. In the red part of the spectrum are seen the absorptions corresponding to the Fraunhofer groups A and B. Less sharply defined absorption bands are seen in the orange, citron, and blue, and faint bands in the green and indigo. These band absorptions have a totally different character from the great line absorptions of A and B. Beyond the visible spectrum, photographs show some absorptions in the ultra-violet, and the extreme ultra-violet rays are wholly absorbed. This complete absorption extends nearly to the limit of the solar spectrum. This proves that the earth's atmosphere limits the rays which can reach us from the outside. Ozone has even a more powerful absorptive action, and oxygen, ozonized and unozonized, put a limit to our observations of stellar spectra. Profs. Liveing and Dewar have experimented with a steel tube 60 feet in length, and easily capable of holding a mass of oxygen equal to that contained in a vertical column of the earth's atmosphere of equal section.

Exhibited by Mr. Francis Galton, F.R.S:—Reaction-time instrument (working model). The time is measured by a half-second pendulum. The signal is the sharp sound made by a small hammer (noiselessly set free) on its striking a detent, and thereby releasing the pendulum. The response is made by touching a key that releases an arrangement (worked very quickly by a spring) whereby an elastic thread, which is secured above and below to the pendulum, parallel to its rod, but not touching it, is nipped and held fast against a horizontal bar. The bar is graduated to hundredths of a second, so that the graduation opposite to the thread shows the elapsed time between the signal and the response. The pendulum receives no jar, and continues to vibrate.

Exhibited by the Hon. A. Holland-Hibbert:—(1) Old telescope, with parchment tubes. (2) Old microscope, of stamped leather. Both formerly the property of King Charles I.

Exhibited by Mr. Fred. Enock:—Microscopical preparations illustrating the life-history of the Hessian fly (*Cecidomyia destructor*, Say).

Exhibited by Mr. Percy E. Newberry, by kind permission of the Director of the Royal Gardens, Kew:—A series of ancient funeral wreaths and plant remains, discovered last year by Mr. W. M. Flinders Petrie, in the cemetery of Hawara, Egypt. (I.) The wreaths, which are of Egyptian and Greek manufacture, were all made in the first century B.C., and were found in wooden coffins, either resting on the heads or surrounding the bodies of the mummies. Among them the following are of special interest:—(1) A very perfect wreath composed of the flowerheads of a species of Immortelle (*Gnaphalium luteo-album*, L.), called by the ancients "helichrysos," and much used by them in making garlands. Helichrysos wreaths are mentioned by Pliny ("Hist. Nat.," xxi. 96) as having been used in Egypt in Ptolemaic times, also by Theophrastus, Athenæus, Cratinus, &c. (2) Portion of a curious garland made of cones of papyrus pith, lychnis and rose flowers, rose petals, and scarlet berries of the woody nightshade. These latter are mentioned by Pliny as having been employed in garland-making by the Egyptians. (3) Portion of a wreath (of Greek manufacture) made of flowers of the Polyanthus Narcissus (*N. Tazetta*, L.). Wreaths made of this flower, the "clustered Narcissus" of the ancients, are often mentioned by early Greek poets. Sophocles thus alludes to them:—

> *θάλλει δ' οὐρανίας ὑπ' ἄχνας*
> *ὁ καλλίβοτρος κατ' ἦμαρ ἀεὶ*
> *νάρκισσος, μεγάλαιν θεαῖν*
> *ἀρχαῖον στεφάνωμα.*—*Œdipus Coloneus.*

(4) Portion of a wreath made of the flowers of a species of rose (*Rosa sancta*, Richards). (5) A perfect wreath composed of rose petals threaded by a needle on to strips of twine. "Recently," writes Pliny in his history of garlands, "the rose chaplet has been adopted, and luxury has now arisen to such a pitch that rose garlands are held in no esteem at all if they do not consist entirely of petals sewn together with the needle" ("Hist. Nat.," xxi. 8). There are also exhibited: (6) a portion of a wreath composed of twigs of sweet marjoram (*Origanum Majorana*, L.), lychnis flowers, coils of papyrus pith, and pieces of copper tinsel; (7) a portion of a wreath composed of chrysanthemum flowers and leaves, purple cornflowers, and petals of the flower of a species of *Hibiscus*; (8) a portion of a wreath made of flowers of *Matthiola Librator*, L., flowers of the polyanthus, narcissus, and *Hibiscus* petals; (9) portions of two necklaces made of flowers of the date palm threaded on strips of twine; and (10) a fragment of a necklace made of fruits of the date palm. (II.) Among the plant remains are peach stones, dates, and date stones, walnut shells, currants, pomegranates, plums, figs, chick peas, common garden beans and peas, lentils, wheat, barley, and oats. These are probably the remains of the ancient funeral feasts which were held in the Hawara Cemetery by the relatives of the deceased people who were buried there. The whole collection (of which the series here exhibited is only the third part) is fully described by Mr. Percy E. Newberry in Mr. Flinders Petrie's "Hawara, Biahmu, and Arsinoe."

Exhibited by Dr. H. H. Hoffert:—Photograph of lightning flashes taken at Ealing, on June 6, 1889.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Harkness Scholarship, for Geology and Palæontology, has been awarded to T. T. Groom, Scholar of St. John's College.

Mr. J. T. Nicolson, B.Sc. of Edinburgh University, has been appointed Demonstrator in Mechanism and Applied Mechanics.

The Mechanical Workshops Syndicate reports that the practical instruction in engineering and mechanism is producing excellent results in the training of engineers, but that the subject suffers by the lack of a higher technical examination analogous to a tripos, while the workshops do not get all the work they might do, owing to the withdrawal of the University Museums' work.

An examination for Scholarships in mathematics and in chemistry and physics will be held at Peterhouse on October 15. A syllabus of subjects may be obtained from the tutor.

The local lectures in science have been largely attended during the past year; the largest audiences being at Kettering, where astronomy was the subject, and Mr. J. D. McClure the lecturer, and at Lancaster, where Mr. E. A. Parkyn lectured on human physiology.

The Students' Associations have made good progress in many localities, and in Surrey a student, Mr. Broderick, of Guildford, was found sufficiently qualified to repeat the courses in several villages with much success.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 6.—"Notes on the Absorption-Spectra of Oxygen and some of its Compounds." By Profs. Liveing and Dewar.

The authors give a diagram representing the absorption, both in the visible and in the ultra-violet parts of the spectrum, of 18 metres of ordinary oxygen gas at a pressure of about 97 atmospheres—that is, of a mass of oxygen rather greater than is contained in a vertical column of equal section of the earth's atmosphere. Under the circumstances of the experiment the absorptions A and B are very black, and the lines of which they are composed appear much broader than in the ordinary solar spectrum. The other bands are all diffuse at their edges, and, so far as observed, unresolvable into lines. The complete absorption of the ultra-violet rays does not extend quite so far down as the limit of the solar spectrum, though it approaches that limit. There is a diffuse edge of gradually diminishing absorption succeeding the complete absorption, and this fact, together with the rapid diminution of the extent of the complete absorption with decrease of pressure, lead the authors to class this absorption of the extreme rays with the diffuse bands, which, according to Janssen, increase in intensity as the square of the density of the gas. If that be so, it is unlikely that the limit of the solar spectrum is due to the absorption of ordinary oxygen. For though we may suppose interplanetary space to be pervaded by materials similar to our atmosphere, yet they must be in such a state of tenuity that, although they may to some extent reinforce A and B, they will not add sensibly to the strength of the diffuse bands. Moreover, these bands, though identical in position, so far as the blue and less refrangible part of the spectrum is concerned, with bands observed by Brewster and others in the solar spectrum, are seen much more strongly through tubes of compressed oxygen than they appear in the solar spectrum with a low sun. The ultra-violet bands, of which the one near N appears in photographs nearly as strong as the band just above F, and that in the indigo, have not, so far as the authors are aware, been noticed in the solar spectrum. Probably they would appear if photographs were taken with small dispersion when the sun was low.

As the pressure in the tube diminished, the bands rapidly faded; that in the indigo, with an oscillation-frequency or wave number about 2240, was the first to disappear, then those near L and O and that near E. At the same time the limit of the transmitted ultra-violet light advanced from an oscillation-frequency of about 3575 at 97 atmospheres, to 3710 at 50 atmospheres and 3848 at 23 atmospheres. At 20 atmospheres the three bands above C, D, and F, respectively, were still visible, though faint. B remained visible until the pressure was reduced to 2 atmospheres, and A could still be seen, but with difficulty, when the pressure of the 18 metres of oxygen was reduced to 1 atmosphere.

When atmospheric air was substituted for oxygen the authors found that 7 atmospheres was the limit of pressure at which they could certainly distinguish A, and 18 atmospheres the limit at which they could see B. It is a difficult matter to say exactly when an absorption becomes invisible, but the observations on air were made under the same circumstances as those on oxygen, and the two sets of observations were fairly comparable. With air at 75 atmospheres the three bands above C, D, and F, respectively, could all be seen, but that near C only with difficulty. The mass of oxygen and its *partial* pressure in the tube was in this case less by about one-quarter than that which was required to bring out the bands when oxygen alone was used. The cause of this may be that the development of the diffuse bands depends in some degree on the total pressure of the air, and not only on the partial pressure of the oxygen in it.

The mass of oxygen which when unmixed with nitrogen made A visible would correspond to that in the tube filled with air at 5 atmospheres, and that which made B visible would correspond to air at 10 atmospheres. The differences between these pressures and those which are actually needed to render A and B visible seem too great to be ascribed to errors of observation, and seem to indicate that the addition of the nitrogen has some effect on the absorptive action of the oxygen. On the other hand, Egoroff found that he could still distinguish A when the thickness of air at ordinary pressure was reduced to 80 metres (*Compt. Rend.*, vol. ci. p. 1144). This amount of air corresponds to rather less oxygen than the 18-metre tube would